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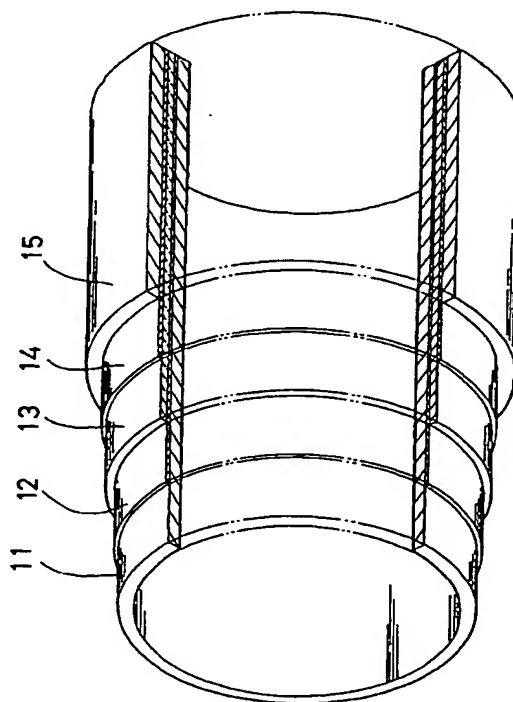
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(54) Fuel transfer tube.

(57) A fuel transfer tube comprises an inner layer (11,21) of hot-melt fluororesin, which reliably prevents alcohol from permeating into the tube, and an outer layer of partial aromatic polyamide resin (13, 23) or ethylene-vinyl alcohol copolymer (17, 27) which effectively prevents gasoline from permeating into the tube. The tube, therefore, is suitable for transferring alcohol, gasoline or a mixture thereof.

Fig. 1



EP 0 559 445 A1

The present invention relates to a tube for transferring an alcohol mixed fuel (hereinafter referred to as a fuel transfer tube).

Various kinds of fuel transfer tubes have been already proposed, such as a tube made of metal, a tube made of Nylon 11 or 12, a tube having an innermost layer made of Nylon 6, 12, polyolefin, or ethylene-vinyl alcohol copolymer, and so forth.

Permeability tests (1) of alcohol and gasoline and flexibility evaluation tests (2) were conducted using some of the above known tubes. The tubes used in the tests measured 8 mm in outside diameter and 6 mm in inside diameter. The criterion (3) of the permeability test and the flexibility evaluation test is shown below and the results of the tests are also shown below in Table 1.

[Test methods]

(1) Permeability test

A strip of 1,000 mm of the tube (outside diameter 8mm, inside diameter 6mm) was filled with each sample liquid, and left to stand in a 60° C oven, and the weight loss thereof was measured at specific time intervals.

The permeability is determined by the weight loss per 1000 mm of the tube per day (rate of permeation : g/m/day).

(Sample liquids)

1. Regular gasoline : Gasoline available at an ordinary gas station.
2. Fuel C : A mixture of reagent class toluene and reagent class iso octane at 1:1 by volume.
3. Methanol : Reagent class methanol as is.
4. FAM15 : A mixture of the Fuel C and methanol by 85:15 by volume.

(2) Flexibility evaluation tests

The end of a 400mm-long strip of the tube being held, the load required for bending 180 degrees around the surface of a semicircular disc of 100 mm in radius was measured, by which the flexibility of the tube was determined.

(3) Criterion (outside diameter 8 mm, inside diameter 6 mm)

Permeability (rate of permeation)

1. Regular gasoline : 0.005 g/m/day or less
2. Fuel C : 0.005 g/m/day or less
3. Methanol : 0.2g/m/day or less
4. FAM15 : 0.2g/m/day or less

Flexibility

1.0 kgf or less

[Test results]

Table 1. Comparative Examples

Ex- amples	Layer composition (inside → outside)					Permeability $\phi 8 \times \phi 6$ (g/m/day)					Flex- ibility (kgf)
	Inner layer	Adhesive Layer	Middle Layer	Adhesive Layer	Outer Layer	Regular Gasoline	Fuel C	Methanol	FAM15		
1	Nylon 11 without plasticizer					0.006	0.03	3.4	1.3	1.3	
2	Nylon 12 without plasticizer					0.03	0.08	6.8	1.8	1.3	
3	Nylon 11 with plasticizer (about 14%)					0.11	0.18	3.3	2.9	0.5	
4	Nylon 12 with plasticizer (about 14%)					0.30	0.56	8.1	3.2	0.5	
5	Polyvinylidene fluoride resin (PVDF)					0.0005	0.005	0.13	0.11	1.8	
6	Ethylene-ethylene tetrafluoride copolymer (ETFE)					0.01	0.01	0.03	0.02	1.1	
7	Nylon 6 (Thickness:0.2mm)	Ethylene-vinyl Alcohol Copolymer (EVOH) (0.1)	Nylon 6 (0.3)	Denatured polyolefin (0.1)	Nylon 12 (0.3)	0.0009	0.0007	1.42	0.8	0.8	
8	Denatured polyolefin (Thickness:0.2mm)	Nylon 12 (0.8)				0.35	0.65	1.05	3.0	0.6	
9	Nylon 12 (Thickness:0.1mm)	Denatured polyolefin (0.05)	EVOH (0.1)	Denatured polyolefin (0.05)	Nylon 12 (0.5)	0.0012	0.001	1.0	2.9	0.6	
10	EVOH (Thickness:0.2mm)	Denatured polyolefin (0.1)	Nylon 12 (0.1)			0.001	0.0008	2.0	3.1	0.7	
11	Partial aromatic polyamide resin					0.0001	0.0001	2.9	1.2	5.5	
12	EVOH					0.0005	0.0004	5.6	3.3	2.0	

Comparing the test results shown in Table 1 with the criterion (3), it is found that none of the comparative examples was satisfactory all in gasoline permeability, alcohol permeability and flexibility.

It is hence a primary object of the present invention to provide a tube which is especially sufficient in the above gasoline and alcohol permeability, that is, a fuel transfer tube suitable for transferring alcohol, gasoline, and a mixture thereof.

The fuel transfer tube of the present invention comprises an inner layer of hot-melt fluororesin, and an outer layer of partial aromatic polyamide resin or ethylene-vinyl alcohol copolymer.

In the fuel transfer tube of the present invention, the layer of hot-melt fluororesin reliably prevents alcohol from permeating into the tube, while gasoline is effectively prevented from permeating into the tube by the layer of partial aromatic polyamide resin or ethylene-vinyl alcohol copolymer. Furthermore, by means of the inner layer of hot-melt fluororesin, the tube is excellent in resistance to fuel oil and sour gasoline, and non-eluting property.

Fig. 1 is a sectional perspective view of Embodiment 1 of a fuel transfer tube of the present invention.

Fig. 2 is a sectional perspective view of Embodiment 2 of a fuel transfer tube of the invention.

Fig. 3 is a sectional perspective view of Embodiment 3 of a fuel transfer tube of the invention.

Fig. 4 is a sectional perspective view of Embodiment 4 of a fuel transfer tube of the invention.

Referring now to the accompanying drawings, some embodiments of the present invention are described below.

Embodiment 1

The tube of Embodiment 1 is composed of five layers as shown in Fig. 1 and is 8mm in outside diameter and 6mm in inside diameter. The tube is formed by laminating a polyvinylidene fluoride PVDF layer 11, an ethylene-vinyl acetate-glycidyl methacrylate copolymer layer 12, a partial aromatic polyamide MXD6 layer 13, a denatured polyolefin layer 14, and a plasticized Nylon 11 layer 15 in sequence from inside to outside. The layers 11, 12, 13, 14, and 15 are respectively 0.2mm, 0.05mm, 0.1mm, 0.05mm and 0.6mm in thickness.

Embodiment 2

The tube of Embodiment 2 is composed of five layers as shown in Fig. 2, and is also 8mm in outside diameter and 6mm in inside diameter. The tube is formed by laminating an ethylene-ethylene tetrafluoride copolymer ETFE layer 21, an ethylene-methyl acrylate-glycidyl methacrylate copolymer layer 22, a partial aromatic polyamide MXD6 layer 23, an acid denatured polystyrene-ethylene butadiene copolymer layer 24, and a polyester elastomer layer 25 in order from inside to outside. The layers 21, 22, 23, 24, and 25 are respectively 0.3mm, 0.05mm, 0.1mm, 0.05mm, and 0.5mm in thickness.

Embodiment 3

The tube of Embodiment 3 is composed substantially similar to Embodiment 2. Instead of the ethylene-methyl acrylate-glycidyl methacrylate copolymer layer 22 in Embodiment 2, however, an epoxy adhesive layer is provided. And the outer surface of the ethylene-ethylene tetrafluoride copolymer ETFE layer 21 is treated to enhance the wettability and adhesion of the epoxy adhesive.

Embodiment 4

The tube of Embodiment 4 comprises five layers as shown in Fig. 3, and measures 8mm in outside diameter and 6mm in inside diameter. The tube is formed by laminating a polyvinylidene fluoride PVDF layer 11, an acid denatured ethylene-ethyl acrylate copolymer layer 16, an ethylene-vinyl alcohol copolymer layer 17, a denatured polyolefin layer 14, and a plasticized Nylon 11 layer 15 in sequence from inside to outside. The layers 11, 16, 17, 14, and 15 are respectively 0.2mm, 0.05mm, 0.1mm, 0.05mm, and 0.6mm in thickness.

Embodiment 5

The tube of Embodiment 5 comprises six layers as shown in Fig. 4, and the outside diameter and the inside diameter thereof are still 8mm and 6mm respectively. The tube is formed by laminating an ethylene-ethylene tetrafluoride copolymer ETFE layer 21, an ethylene-methyl acrylate-glycidyl methacrylate copolymer layer 22, a denatured polyolefin layer 26, an ethylene-vinyl alcohol copolymer layer 27, a denatured polyolefin layer 28, and a plasticized Nylon 11 layer 29 in sequence from inside to outside. The layers 21, 22, 26, 27, 28 and 29

are respectively 0.2mm, 0.05mm, 0.05mm, 0.1mm, 0.1mm, and 0.5mm in thickness.

Embodiment 6

The tube of Embodiment 6 is composed substantially similar to Embodiment 5. Here the layers 22, 26 are replaced with an epoxy adhesive layer. Treatment to enhance the wettability and adhesion of the epoxy adhesive is applied to the outer surface of ethylene-ethylene tetrafluoride copolymer ETFE layer 21.

Embodiment 7

The tube of Embodiment 7 includes six layers and is 8mm in outside diameter and 6mm in inside diameter. The tube is formed by laminating, in sequence from inside to outside, a polyvinylidene fluoride PVDF layer, an ethylene-glycidyl methacrylate copolymer layer, a denatured polyolefin layer, an ethylene vinyl alcohol copolymer layer, a denatured polyolefin layer, and a high density polyethylene layer. The thicknesses thereof are respectively 0.1mm, 0.05mm, 0.05mm, 0.1mm, 0.1mm, and 0.6mm.

Comparing the results in Table 2 and the criterion (3) shown above, the tubes of Embodiments 1 to 7 of the present invention were found to be highly effective in impermeability and flexibility.

Any known methods such as coextrusion forming and extrusion coating may be arbitrarily employed as a method of forming the fuel transfer tubes of Embodiments 1, 2, 4, 5, and 7 of the present invention. In particular, a coextrusion forming method using five extruders and a tube die for multiple layers may produce endless tubes efficiently.

On the other hand, the fuel transfer tube of Embodiments 3 and 6 of the present invention may be produced firstly by forming an ETFE tube, treating the surface of the tube by corona discharge, applying an epoxy adhesive on the treated surface, and secondly by covering thus formed tube with outside layers extruded from a tube die for three kinds and three layers.

All the tubes in the foregoing embodiments are composed of five or six layers, however, so long as the tubes have a layer of hot-melt fluororesin inside and another layer of partial aromatic polyamide resin or ethylene-vinyl alcohol copolymer outside, other layer or layers are not limited.

The principle resins mentioned above are defined below. The tubes of the present invention were tested by the same methods as mentioned above in relation to the prior art and the results are given in Table 2.

Definition of Principle Resins

(Partial Aromatic Polyamide Resins)

The partial aromatic polyamide resins used in the present invention are polyamide containing a diamine component and a dicarboxylic acid component. One or two of the said two components may include a portion (or a component) having an aromatic ring in the molecular chain and the portion may be just a part of each of the said components or the portion may comprise the whole of one of the said components.

Furthermore, the other portion or portions (or other component or components) having no aromatic ring in the molecular chain may include an aliphatic or alicyclic component, and the polyamide is obtainable by condensation polymerization of the above.

The components for forming the said partial aromatic polyamide resins include, for example, as an aromatic dicarboxylic acid, terephthalic acid, isophthalic acid, phthalic acid, 2-methyl terephthalic acid, 2,5-dimethyl terephthalic acid, naphthalene dicarboxylic acid and the like. On the other hand, as an aromatic diamine, methaxylene diamine (MXDA), paraxylene diamine, and so forth are included.

As an aliphatic dicarboxylic acid, for example, malonic acid, succinic acid, glutaric acid, adipic acid, sebacic acid, undecanic acid, dodecanic acid and the like may be used. And as an aliphatic diamine, for example, ethylene diamine, trimethylene diamine, tetramethylene diamine, pentamethylene diamine, hexamethylene diamine (HMDA), dodecamethylene diamine, 2,2,4,4-trimethyl hexamethylene diamine (TMD), 5-methyl nona methylene diamine, 2,4-dimethyl octa methylene diamine and others may be employed.

An alicyclic diamine includes, for example, 4,4'-diamino dicyclohexylene methane, 4,4'-diamino-3,3'-dimethyl dicyclohexylene methane (CA), and others.

Practical examples of the partial aromatic polyamide resins include, for example, polyamide MXD6 composed of MXDA and adipic acid, polyamide 6T composed of HMDA and terephthalic acid, polyamide 6I composed of HMDA and Isophthalic acid, polyamide 6T/6I composed of HMDA and terephthalic acid/isophthalic acid, polyamide composed of TMD and terephthalic acid, polyamide composed of HMDA/CA and terephthalic acid/isophthalic acid, polyamide 66/6T/6I composed of HMDA and adipic acid/terephthalic acid/isophthalic

acid, and polyamide composed of CA, terephthalic acid/isophthalic acid and further lauryl lactam.

The partial aromatic polyamide resins of the present invention may be used either alone or by blending with a small amount of aliphatic polyamide or the like. Furthermore a variety of stabilizers and additives may be added and blended therein.

5 Commercial examples of such partial aromatic polyamide resins available in the market include MX Nylon of Mitsubishi Gas Chemical Co., ARLEN of Mitsui Petrochemical Co., Nydur of Bayer AG, Ultramid T of BASF AG, Novamid X21 of Mitsubishi Chemical Co., Selar PA of Du Pont, Grivory and Grilamid TR of EMS, Amodel of Amoco, and Trogamid of Hüls.

10 (Ethylene-vinyl alcohol copolymers)

The ethylene-vinyl alcohol copolymers used in the present invention are obtained by saponification of ethylenevinyl acetate copolymer, and a compound with an ethylene content of 60 mol% or less and a degree of saponification of 90% or more is usually preferably employed.

15 The copolymers, or the resins, may be blended with ordinary additives, such as antioxidant and forming aid. Furthermore, in order to improve the processability of EVOH, a small amount of ethylene-vinyl alcohol copolymer with a vinyl alcohol content of less than 40 mol% may be blended therein.

(Hot-melt fluororesins)

20 Fluororesins are intrinsically excellent in resistance to corrosion and chemicals, and also highly effective in non-absorption of water, wear resistance, non-tackiness, self-lubricity, heat and cold resistance, and weather resistance.

Among fluororesins, polyethylene tetrafluoride has a melt index of 10^9 to 10^{12} poise at 300 °C. It is a thermoplastic resin, but poor in thermoplasticity, and cannot be melted and formed in ordinary procedures.

25 Fluororesins used in the present invention are therefore thermoplastic as well as capable of extrusion molding, such as polyvinylidene fluoride resin (PVDF), ethylene-ethylene tetrafluoride copolymer resin (ETFE), polyvinyl fluoride resin (PVF), ethylene-chloride trifluoroethylene copolymer resin (E-CTFE), polychloride trifluoride ethylene resin (PCTFE), ethylene tetrafluoride-propylene hexafluoride copolymer resin (FEP), ethylene tetrafluoride-perfluoroalkoxy ethylene copolymer resin (PFA), and ethylene tetrafluoride-propylene hexafluoride-perfluoroalkoxy ethylene copolymer resin (EPA), and others.

PVDF and ETFE are particularly preferable among them from the viewpoint of forming-processability and adhesion to other resins.

35 (Polyvinylidene fluoride resins)

The polyvinylidene fluoride resins (PVDF) used in the present invention are homopolymer of vinylidene fluoride, or copolymer of vinylidene fluoride and copolymerisable monomer. Examples of copolymerizable monomers include, for example, vinyl fluoride, ethylene tetrafluoride, ethylene chloride trifluoride, propylene hexafluoride, and others.

(Ethylene-ethylene tetrafluoride copolymer resins)

45 The ethylene-ethylene tetrafluoride copolymer resins used in the invention are copolymers of which molar ratio of ethylene/ethylene tetrafluoride is in a range of 30/70 to 60/40, the copolymer being blended with, if necessary, a small amount of other copolymerizable monomer.

(Adhesion of innermost layer and middle layer)

50 Since fluororesins are generally non-sticky, it is difficult to adhere them to other substrates.

Various techniques in adhering fluororesins have been proposed, and the means of adhesion in the present invention is not particularly limited so long as not departing from the object of the invention.

As a method of adhesion, adhesive resins as the other substrate to which fluororesins are adhered are proposed. For example, specific ethylene-ester acrylate copolymer, ethylene-vinyl acetate copolymer, their denatured compounds, polyolefin containing epoxy group, and resin composition of copolymer grafting vinylidene fluoride and methyl methacrylate polymer are known.

On the other hand, methods to enhance adhesion by reforming the surface of a fluororesin are known. These methods include, for example, the method wherein alkaline metal is treated by being immersed in a liquid

in which ammonia or naphthalene is dispersed, and the method of processing by corona discharge, plasma discharge or sputter etching. Conditions in the methods are suitably determined respectively by the known art.

5 (Layer outside of middle layer)

As long as an innermost layer is of hot-melt fluoro-resin, another layer outside of the innermost layer is of partial aromatic polyamide resin or ethylene-vinyl alcohol copolymer, an adhesive layer or an adhesive treatment is provided between the two layers, and the above layers are formed into a tube, other outer layer or
10 layers are not limitative and no layer may be provided there.

However, if the wall thickness of a fuel transfer tube is extremely small with respect to the outside diameter thereof, when the tube is bent, it may be buckled or folded to interrupt the flow of liquid. Or a proper wall thickness is necessary when a joint, which is generally needed to connect the tube with other tool, is attached to it. Moreover outermost layers are usually required to have characteristics of weather resistance, flaw resistance,
15 tance, wear resistance, flexibility, flame retardation, coloring property, printability, antistatic property, electric insulation, and pressure resistance. It is therefore preferably to laminate another layer or layers of other substance having required characteristics as outermost layers.

For example, where antistatic property is required, a resin with volume intrinsic resistance of about 10^2 to $10^9 \Omega \cdot \text{cm}$ may be used, while where strength against pressure is required, a braided layer of fibers may be
20 provided.

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[Test results]

Table 2. Embodiments

Embodiments	Layer Composition (Inside — Outside)					Permeability $\phi 8 \times \phi 6$ (g/m/day)			Flexibility (kgf)	
	Inner Layer	Adhesive Layer	Middle Layer	Adhesive Layer	Outer Layer	Regular Gasoline	Fuel C	Methanol		
1	Polyvinylidene fluoride (PVDF)	Ethylene-vinyl acetate-glycidyl methacrylate copolymer	Partial aromatic polyamide (W006)	Denatured polyolefin	Plasticized nylon 11	0.0001	0.0001	0.14	0.13	0.8
	(Thickness) 0.2mm	0.05	0.1	0.05	0.6					
2	Ethylene-ethylene tetrafluoride copolymer (E ETFE)	Ethylene-methyl acrylate-glycidyl methacrylate copolymer	Partial aromatic polyamide (W006)	Acid denatured polystyrene-ethylene butadiene copolymer	Polyester elastomer	0.0001	0.0001	0.04	0.04	0.8
	(Thickness) 0.3mm	0.05	0.1	0.05	0.5					
3	Ethylene-ethylene tetrafluoride copolymer (E ETFE)	① Treatment of corona discharge ② Epoxy adhesive	Partial aromatic polyamide (W006)	Acid denatured polystyrene-ethylene butadiene copolymer	Polyester elastomer	0.0001	0.0001	0.04	0.04	0.9
	(Thickness) 0.3mm	0.05	0.1	0.05	0.5					
4	Polyvinylidene fluoride (PVDF)	Acid denatured ethylene-ethyl acrylate copolymer	Ethylene-vinyl alcohol copolymer	Denatured polyolefin	Plasticized nylon 11	0.0008	0.0007	0.15	0.13	0.8
	(Thickness) 0.2mm	0.05	0.1	0.05	0.6					
5	Ethylene-ethylene tetrafluoride copolymer (E ETFE)	① Ethylene-methyl acrylate-glycidyl methacrylate copolymer ② Denatured polyolefin	Ethylene-vinyl alcohol copolymer	Denatured polyolefin	Plasticized nylon 11	0.001	0.001	0.05	0.04	0.7
	(Thickness) 0.2mm	0.05 - 0.05	0.1	0.1	0.5					
6	Ethylene-ethylene tetrafluoride copolymer (E ETFE)	① Treatment of corona discharge ② Epoxy adhesive	Ethylene-vinyl alcohol copolymer	Denatured polyolefin	Plasticized nylon 11	0.001	0.001	0.04	0.05	0.7
	(Thickness) 0.3mm	0.05	0.1	0.05	0.5					
7	Polyvinylidene fluoride (PVDF)	① Ethylene-glycidyl methacrylate copolymer ② Denatured polyolefin	Ethylene-Vinyl Alcohol Copolymer	Denatured polyolefin	High density polyethylene	0.0008	0.0007	0.18	0.16	0.9
	(Thickness) 0.1mm	0.05 - 0.05	0.1	0.1	0.6					

[Note] Forming Methods

Embodiments 1, 2 and 4

5 Plasticize each resin by five extruders, and coextrude the resins by a tube die for five layers/five kinds.

Embodiments 3 and 6

10 Form an ETFE tube, treat the surface thereof with corona discharge, coat it with epoxy adhesive, and cover the tube with outside layers extruded from a tube die for three layers/three kinds.

Embodiments 5 and 7

20 Plasticize each resin by six extruders, and coextrude the resins by a tube die for six layers/six kinds.

25 As known from the description herein, the present invention provides a fuel transfer tube suitable for use in transferring alcohol, gasoline, or a mixture thereof, and excellent in resistance to fuel oil and sour gasoline, impermeability of gasoline, and non-eluting property.

30 Claims

1. A fuel transfer tube comprising at least a first layer and a second layer, the first layer being an inner layer of hot-melt fluororesin (11, 21) and the second layer being an outer layer of partial aromatic polyamide resin (13, 23) or ethylene-vinyl alcohol copolymer (17, 27).
- 35 2. A fuel transfer tube according to claim 1, wherein the hot-melt fluororesin of the first layer (11) is polyvinylidene fluoride resin.
3. A fuel transfer tube according to claim 1, wherein the hot-melt fluororesin of the first layer (21) is ethylene-ethylene tetrafluoride copolymer resin.
- 40 4. A fuel transfer tube according to claim 1, wherein the second layer is a partial aromatic polyamide resin (13, 23) comprising a polyamide containing a diamine component and a dicarboxylic acid component, with an aromatic ring in at least part of the molecular chain of at least one of the two components and an aliphatic or alicyclic component in the other part thereof, and which is obtained by condensation polymerization of the diamine and dicarboxylic acid components.
- 45 5. A fuel transfer tube according to claim 1, wherein the second layer is an ethylene-vinyl alcohol copolymer (17, 27) which is obtained by saponification of ethylene-vinyl acetate copolymer.
- 50 6. A fuel transfer tube according to claim 5, wherein the ethylene-vinyl alcohol copolymer has an ethylene content of 60 mol% or less and a degree of the saponification of 90% or more.
7. A fuel transfer tube according to any preceding claim further comprising an adhesive layer between the first layer (11, 21) and the second layer (13, 23, 17, 27).
- 55 8. A fuel transfer tube according to claim 3, wherein the outside surface of the first layer (21) is treated by corona discharge and an epoxy adhesive layer is provided between the treated surface of the first layer (21) and the second layer (23, 27).

Fig. 1

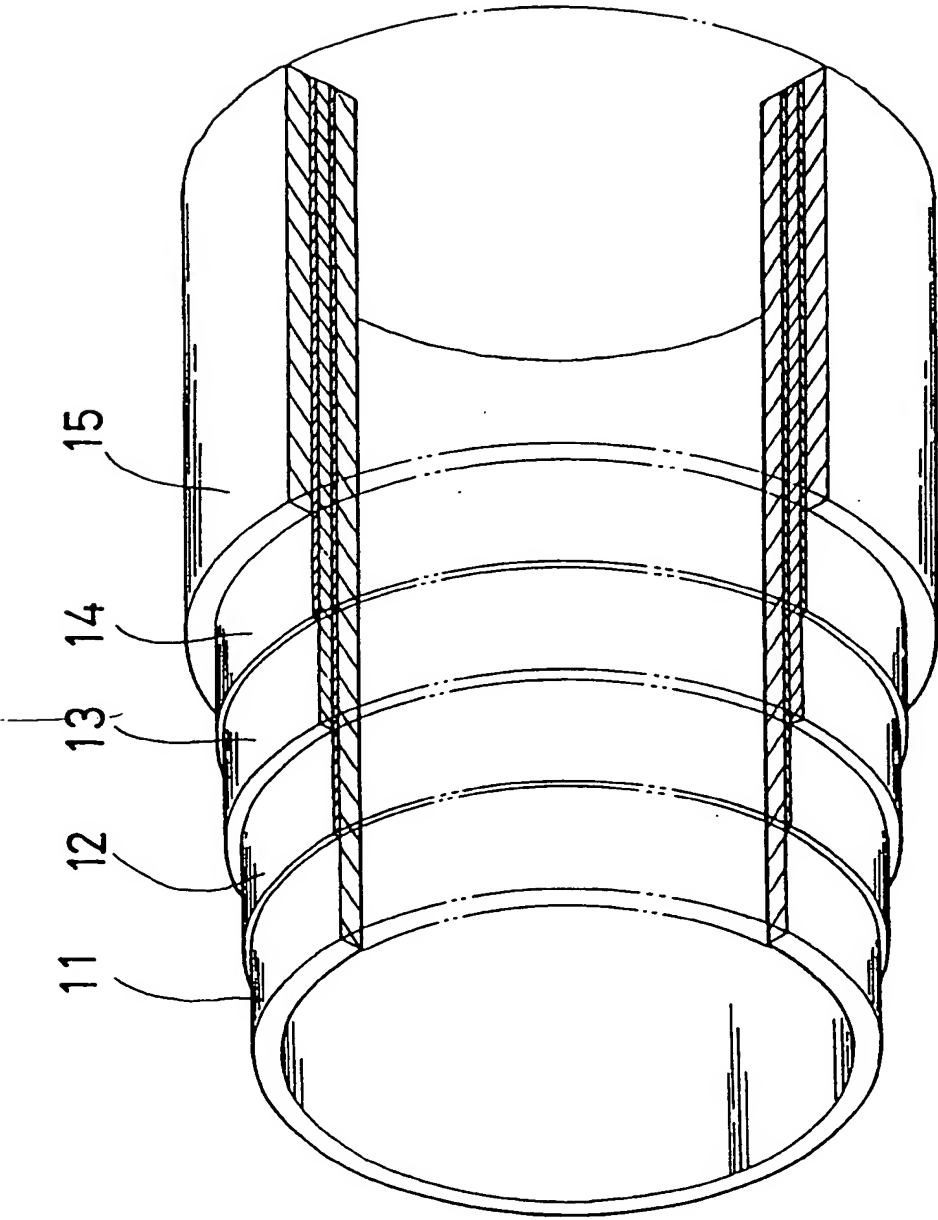


Fig. 2

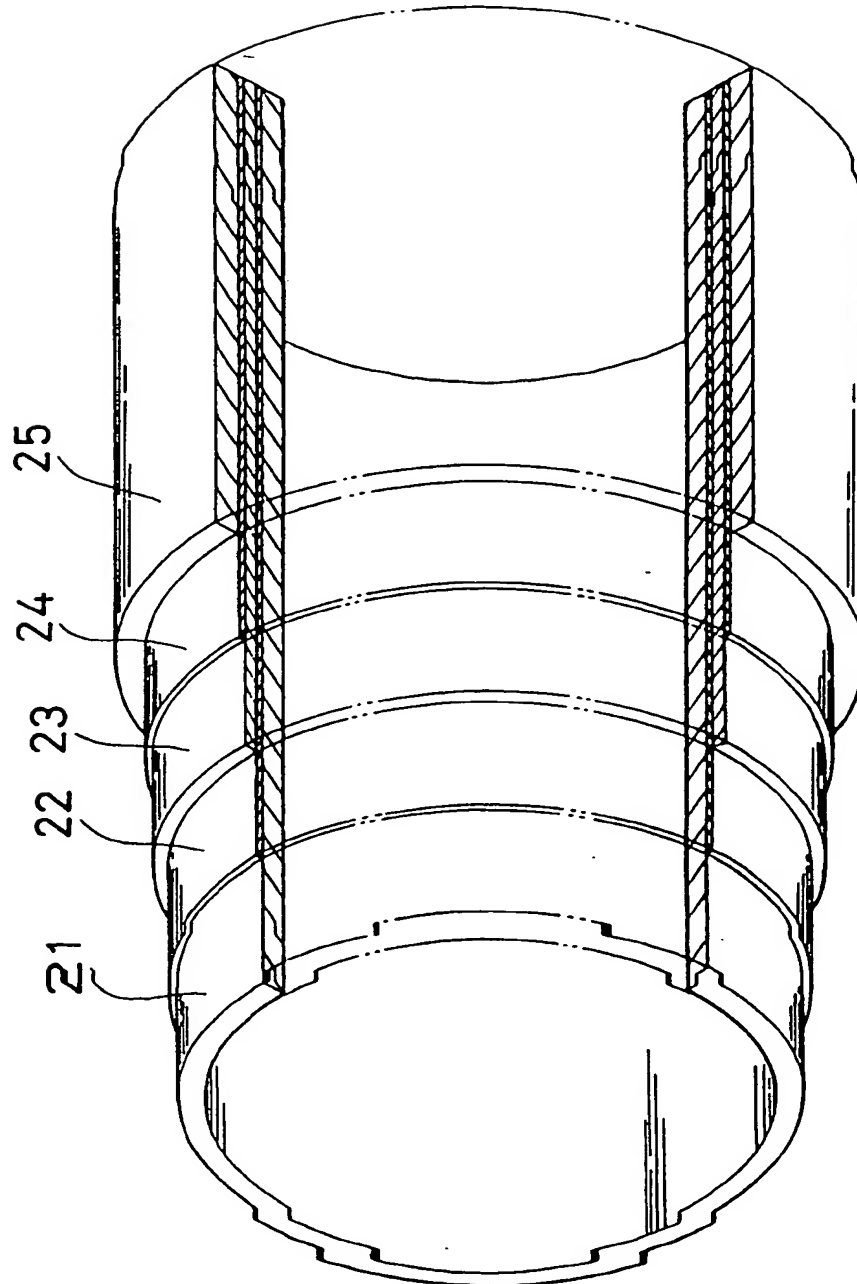


Fig. 3

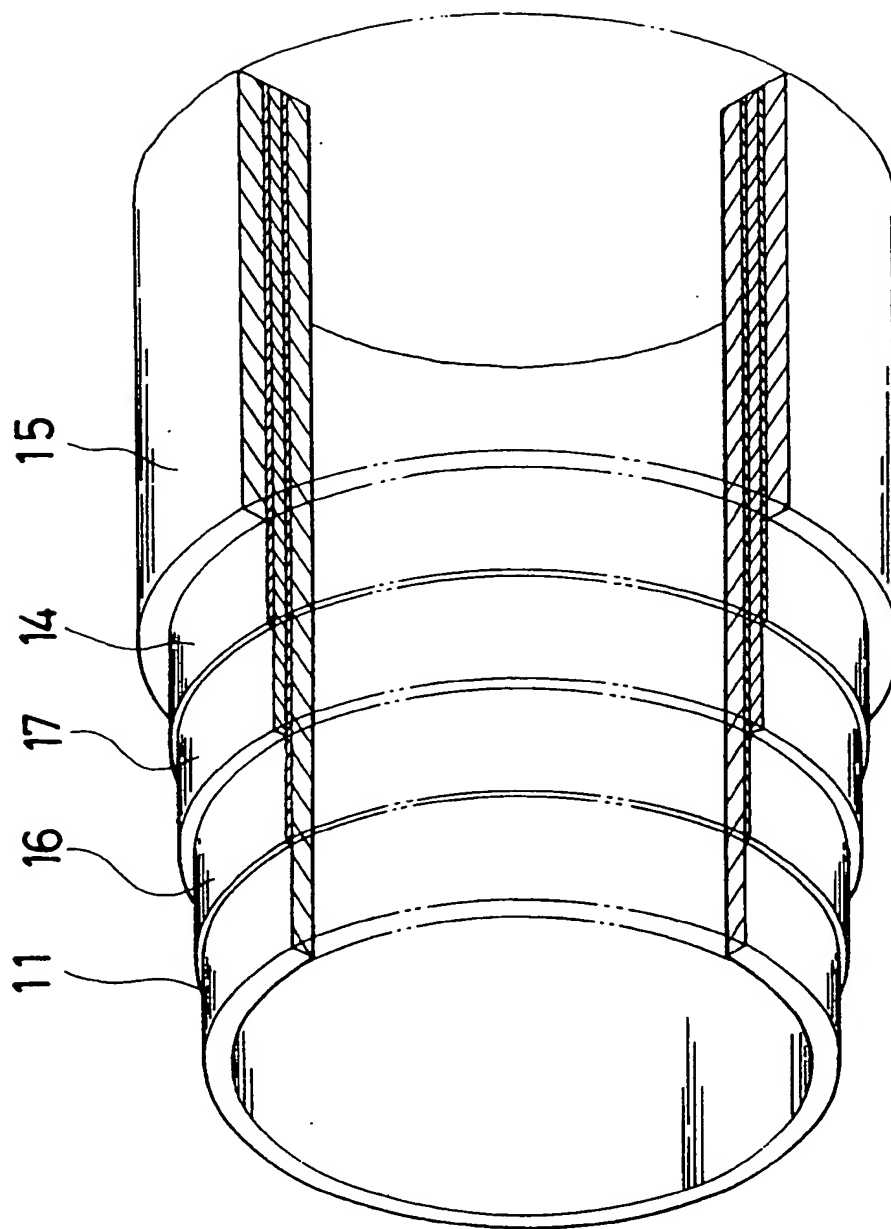
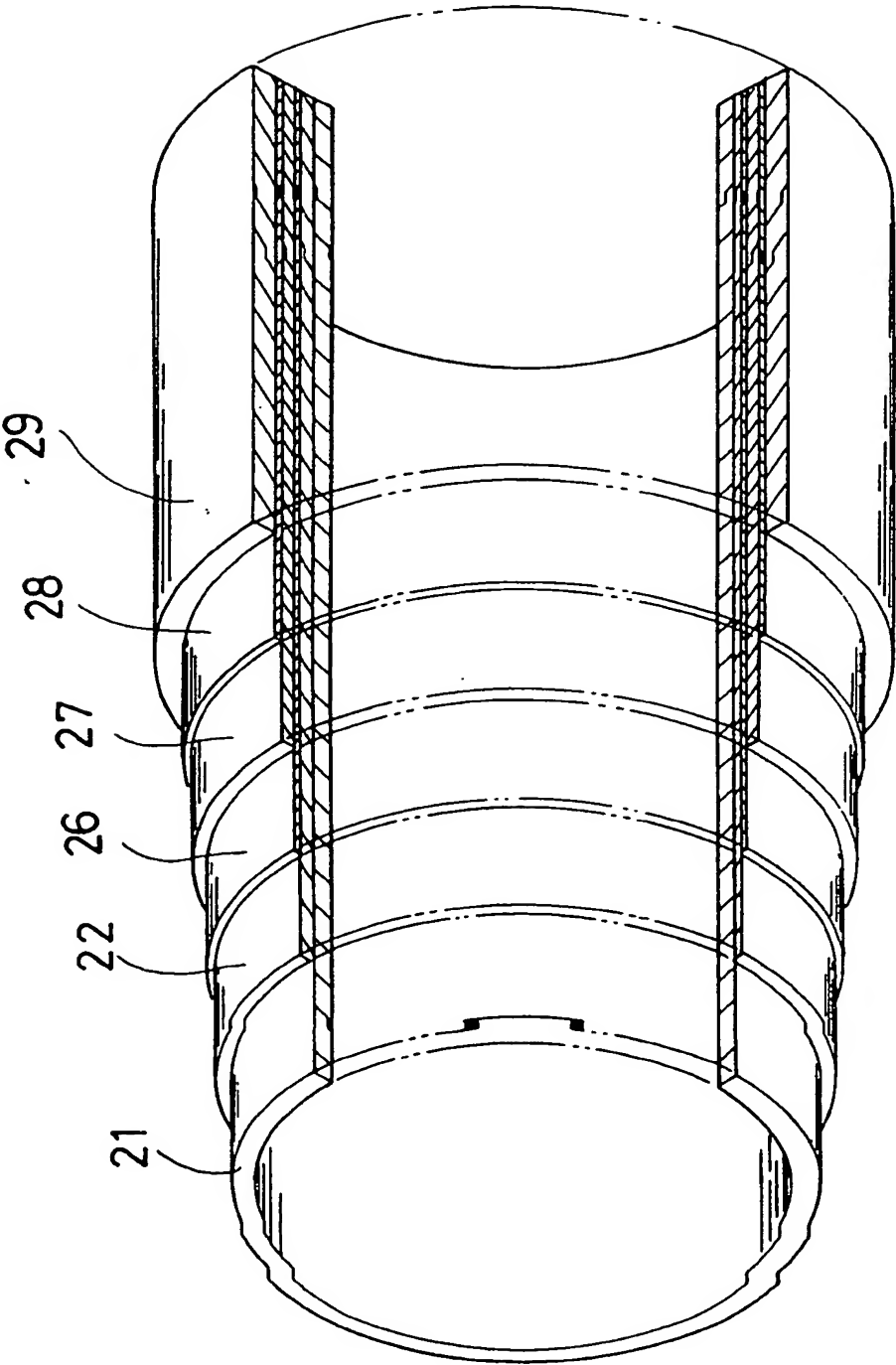


Fig. 4





European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 93 30 1605

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
P,X P,Y	US-A-5 170 011 (TELEFLEX INCORPORATED) * abstract; claims 1-10 * * column 2, line 37 - column 3, line 42 * ---	1,3,4 2	F16L9/12 F16L9/133 F16L11/12
X	DATABASE WPIL Section Ch, Week 8637, Derwent Publications Ltd., London, GB; Class A88, AN 86-242523 & JP-A-61 171 981 (TOKAI RUBBER IND KK) 2 August 1986 * abstract * ---	1,5,6	
Y	DATABASE WPIL Section Ch, Week 8525, Derwent Publications Ltd., London, GB; Class A88, AN 85-149345 & JP-A-60 081 590 (TOKAI RUBBER IND KK) 9 May 1985 * abstract * ---	2	
A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 416 (M-1304)2 September 1992 & JP-A-41 40 585 (TOKAI RUBBER IND LTD) * abstract * ---	1,2	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	US-A-4 330 017 (SATO & SUZUKI) * claim 1 * ---	1	F16L
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 60 (M-931)5 February 1990 & JP-A-12 86 829 (TOYODA GOSEI CO LTD) * abstract * ---	-	
A	EP-A-0 124 931 (SOLVAY & CIE) * abstract * -----	-	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 07 JUNE 1993	Examiner BUDTZ-OLSEN A.
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application. L : document cited for other reasons ----- & : member of the same patent family, corresponding document	
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